1 WHAT IS CLAIMED IS:

2 1.   A distance correcting apparatus of a surroundings
3 monitoring system, comprising:

4   a stereo imaging means for stereoscopically taking a
5 pair of images;

6   a parallax calculating means for calculating a
7 parallax based on said pair of images;

8   a distance calculating means for calculating a
9 distance to an object based on said parallax and a first parameter
10 for correcting said distance;

11   an approximation line calculating means for
12 calculating a plurality of approximation lines extending in the
13 distance direction in parallel with each other based on said
14 images;

15   a vanishing point calculating means for calculating
16 a vanishing point of said images from a point of intersection
17 of said approximation lines; and

18   a parameter correcting means for correcting said
19 first parameter based on said vanishing point.

20

21 2.   The apparatus according to claim 1, further
22 comprising:

23   a reference object detecting means for detecting a
24 plurality of reference objects extending in the distance
25 direction in parallel with each other from a scenery projected

1 in said images and for identifying a position of said reference

2 objects in an image plane of said images.

3

4 3.   The apparatus according to claim 2, wherein

5   said vanishing point calculating means calculates an

6 approximation line in said image plane for respective reference

7 objects, when a plurality of reference objects are detected by

8 said reference objects detecting means.

9

10 4.   The apparatus according to claim 2, wherein

11   said reference objects are lane markers on a road

12 projected in said images and when left and right lane markers

13 are detected on said road, said vanishing point calculating means

14 calculates an approximation line in said image plane for said

15 respective left and right lane markers.

16

17 5.   The apparatus according to claim 4, wherein

18   said vanishing point calculating means calculates said

19 approximation line based on said left and right lane markers

20 existing within a specified distance range.

21

22 6.   The apparatus according to claim 4, wherein

23   said reference object detecting means calculates a

24 lane marker model expressing the change of a road surface height

25 with respect to distance and said first parameter correcting means

1 identifies a condition of change of an actual road surface height

2 based on said vanishing point calculated by said vanishing point

3 calculating means, identifies a condition of change of a

4 calculated road surface height based on said lane marker model

5 calculated by said reference object detecting means, and corrects

6 said first parameter so that said condition of change of said

7 calculated road surface height comes close to said condition of

8 change of said actual road surface height.

9

10 7.   The apparatus according to claim 4, wherein

11   said reference object detecting means calculates a

12 lane marker model expressing the change of a road surface height

13 with respect to distance and said parameter correcting means

14 identifies a first gradient indicating the change of a road

15 surface height with respect to distance based on said vanishing

16 point calculated by said vanishing point calculating means,

17 identifies a second gradient indicating the change of a road

18 surface height with respect to distance based on said lane marker

19 model calculated by said reference object detecting means, and

20 corrects said first parameter so that a deviation of said second

21 gradient with respect to said first gradient becomes small.

22

23 8.   The apparatus according to claim 4, wherein

24   said vanishing point calculating means judges whether

25 or not a lane marker projected in said images is a straight line

1 and in case where it is judged that said lane marker is a straight

2 line, calculates said vanishing point of said images.

3

4 9. The apparatus according to claim 8, wherein

5 said vanishing point calculating means evaluates a

6 time-versus change of the position of a lane marker projected

7 in said images, if said time-versus change is small, judges that

8 said lane marker has a high reliability as lane markers, and

9 calculates said vanishing point in said images.

10

11 10. The apparatus according to claim 9, wherein

12 said parameter is a vanishing point parallax.

13

14 11. A distance correcting apparatus of a surroundings

15 monitoring system, comprising:

16 a stereo imaging means for stereoscopically taking a

17 pair of images;

18 a transforming means for geometrically transforming

19 said pair of images based on a second parameter indicating a

20 transference in the horizontal direction;

21 a parallax calculating means for calculating a

22 parallax based on said pair of images outputted from said

23 transforming means;

24 a distance calculating means for calculating a

25 distance to an object based on said parallax;

1   a vanishing point calculating means for calculating

2 a plurality of approximation lines extending in the distance

3 direction in parallel with each other and calculating a vanishing

4 point of said images from a point of intersection of said

5 approximation lines; and

6   a parameter correcting means for correcting said

7 second parameter based on said vanishing point.

8

9 12.   The apparatus according to claim 11, further

10 comprising:

11   a reference object detecting means for detecting a

12 plurality of reference objects extending in the distance

13 direction in parallel with each other from a scenery projected

14 in said images and for identifying a position of said reference

15 objects in an image plane of said images.

16

17 13.   The apparatus according to claim 12, wherein

18   said vanishing point calculating means calculates an

19 approximation line in said image plane for respective reference

20 objects, when a plurality of reference objects are detected by

21 said reference objects detecting means.

22

23 14.   The apparatus according to claim 12, wherein

24   said reference objects are lane markers on a road

25 projected in said images and when left and right lane markers

47

1   are detected on said road, said vanishing point calculating means

2   calculates an approximation line in said image plane for said

3   respective left and right lane markers.

4

5   15.   The apparatus according to claim 14, wherein

6   said vanishing point calculating means calculates said

7   approximation line based on said left and right lane markers

8   existing within a specified distance range.

9

10   16.   The apparatus according to claim 14, wherein

11   said reference object detecting means calculates a

12   lane

13   marker model expressing the change of a road surface height with

14   respect to distance and said first parameter correcting means

15   identifies a condition of change of an actual road surface height

16   based on said vanishing point calculated by said vanishing point

17   calculating means, identifies a condition of change of a

18   calculated road surface height based on said lane marker model

19   calculated by said reference object detecting means, and corrects

20   said first parameter so that said condition of change of said

21   calculated road surface height comes close to said condition of

22   change of said actual road surface height.

23

24   17.   The apparatus according to claim 14, wherein

25   said reference object detecting means calculates a

lane marker model expressing the change of a road surface height
with respect to distance and said parameter correcting means
identifies a third gradient indicating the change of a road
surface height with respect to distance based on said vanishing
point calculated by said vanishing point calculating means,
identifies a fourth gradient indicating the change of a road
surface height with respect to distance based on said lane marker
model calculated by said reference object detecting means, and
corrects said third parameter so that a deviation of said fourth
gradient with respect to said third gradient becomes small.

18.   The apparatus according to claim 14, wherein
said vanishing point calculating means judges whether
or not a lane marker projected in said images is a straight line
and in case where it is judged that said lane marker is a straight
line, calculates said vanishing point of said images.

19.   The apparatus according to claim 18, wherein
said vanishing point calculating means evaluates a
time-versus change of the position of a lane marker projected
in said images, if said time-versus change is small, judges that
said lane marker has a high reliability as lane markers, and
calculates said vanishing point in said images.

20.   A vanishing point correcting apparatus of a surroundings

1 monitoring system for taking images of a scenery in front of an

2 own vehicle and for obtaining a three-dimensional information

3 of an object projected in said images by making use of an

4 established vanishing point established beforehand, comprising:

5 reference object detecting means for detecting lane

6 markers on a road projected in said images and for identifying

7 a position of said lane markers on an image plane of said images;

8 vanishing point calculating means, when a left and

9 right lane marker is detected on said road and it is judged that

10 said lane marker projected in said images is a straight line,

11 for calculating an approximation line in said image plane for

12 said respective left and right lane markers and for calculating

13 a vanishing point from a point of intersection of said

14 approximation lines; and

15 a vanishing point correcting means for correcting said

16 vanishing point so that said established vanishing point comes

17 close to said vanishing point calculated by said vanishing point

18 calculating means.

19

20 21. The apparatus according to claim 20, wherein

21 said vanishing point calculating means evaluates a

22 time-versus change of the position of a lane marker projected

23 in said images, if said time-versus change is small, judges that

24 said lane marker has a high reliability as lane markers, and

25 calculates said vanishing point in said images.